8. [2360/043022 (20 pts)] Consider the linear system of differential equations given by $\vec{x}' = A\vec{x}$ where $A = \begin{matrix} a & 1 & 1 \\ a & 2 & 1 \end{matrix}$ (a is a real number) and with equilibrium solution $\vec{x} = \begin{matrix} 0 \\ 0 \end{matrix}$.

(a) Is $\vec{x}$ the only possible equilibrium solution? Justify your answer.

(b) For what value(s) of a, if any, will the equilibrium solution $\vec{x}$ be a saddle?

(c) For what value(s) of a, if any, will the equilibrium solution $\vec{x}$ be unstable?

(d) For what value(s) of a, if any, will the equilibrium solution $\vec{x}$